

REMARKS

The Examiner is thanked for the thorough examination of the present application and the withdrawal of the previous rejections. The Office Action, however, tentatively rejected all pending claims 12-20 based in part on newly cited art. Applicant has amended independent claim 12 and dependent claims 14, 16, 17, and 18. Applicant respectfully requests reconsideration and withdrawal of the rejections for at least the following reasons.

Reconsideration and allowance of amended independent claim 12 is respectfully requested in light of the foregoing amendments and the following remarks. Claims 13-20 depend on amended claim 12, and therefore are in condition for allowance for at least the same reasons.

The embodiments defined by amended independent claim 12 define over the USP 6,506,671 in at least the ways described below.

The Office Action rejected claim 12 under 35 U.S.C. § 102(e) as allegedly anticipated by U.S. Patent 6,506,671 to *Grigg*. Application, however, has amended claim 12, and for at least the reasons that follow, Applicant respectfully submits that amended claim 12 defines over the cited art. Specifically, as amended, claim 12 recites:

12. An electronic package comprising:
a device carrier composed of a metal surface *and a lead frame enclosed by said metal surface*;
at least a semiconductor unit including at least an electrode; and
at least an interconnection portion including a first part and a second part, wherein said second part directly contacts said metal surface and said semiconductor unit, both said first part and said second part span between and tie together said metal surface and said semiconductor unit, *said first part and said second part respectively have an end on said metal surface, said end of said second part is surrounded by said end of said first part, said end of said first part is surrounded by said metal surface*, said second part is wrapped by said first part, said first part has a melting point lower than that of said second part, and said first part adheres to said second part.

(*Emphasis added.*) Applicant submits that claim 12 defines over the cited art for at least the

reasons that the cited art fails to disclose at least the features emphasized above.

The device carrier 30 of *Grigg* is a substrate including contact pad 32, which is made of metal. In contrast, the device carrier according to the claimed embodiments is composed of a metal surface 72 and a lead frame 7 enclosed by the metal surface 72. For at least this reason, the rejection should be withdrawn.

Another difference between the claimed embodiments and *Grigg* is noted in the interconnection portion. The second part (solder ball 20') of the interconnection portion between a semiconductor device 10 and a substrate 30 of *Grigg* is partially surrounded by the first part (ring 50'), wherein the first part (ring 50') includes aperture 52 and has a melting point higher than that of the second part (solder ball 20'). In contrast, the second part 5 of the interconnection portion between a semiconductor unit 2 and a device carrier 7 according to the claimed embodiments is surrounded by the first part 3, wherein the first part 3 has a melting point lower than that of the second part 5.

The fact the melting point of the first part (ring 50') according to *Grigg* is higher than that of the second part (solder ball 20') is established by the following statements cited from its specification: "Since the ring protrudes from the surface of the semiconductor device component, when a solder ball is bonded or otherwise secured to the contact pad exposed through the ring, the ring laterally surrounds at least a portion of the solder ball....." in lines 63-67 of col. 3 and lines 1-5 of col. 4; "Another significant advantage of the rings of the present invention is the containment of the solder of the balls, in the manner of a dam, during solder reflow, thus preventing contamination of the passivation layer surrounding the contact pads" in lines 17-21 of col. 4; "Each ring 50 defines an aperture 52 through which at least a portion of the surrounded contact pad 12 is exposed. Each ring 50 protrudes from surface 14 of semiconductor device 10 so

as to laterally surround and contact at least a portion of a solder ball to be bonded or otherwise secured to bond pad 12 and to support that portion of the solder ball to prevent fatigue thereof during thermal cycling of semiconductor device 10" in lines 45-52 of col. 5; "As shown in FIG. 5, solder ball 20' extends through an aperture 52' of ring 50' to contact pad 12" in lines 26-27 of col 6; and "rings 50' prevent material of solder balls 20' from contacting surface 14 of semiconductor device 10" in lines 37-38 of col. 6. The melting point of the first part (ring 50') according to *Grigg* must be higher than that of the second part (solder ball 20') according to the foregoing discussion. For at least this additional reason, amended claim 12 patently defines over *Grigg*.

A further difference between the claimed embodiments and *Grigg* is the distance between the first part of the interconnection portion and the device carrier. There is a distance, as can be clearly seen from Figs. 6 and 3, between the first part (ring 50') and the device carrier (substrate 30) according to the prior art because the first part (ring 50') is fabricated before the semiconductor device 10 is connected to the substrate 30 via the second part (solder ball 20'). In contrast, both the first part 3 and the second part 5 according to the claimed embodiments respectively contact the device carrier 7 and the semiconductor unit 2, and there is no distance between the first part 3 and the device carrier 7, as can be clearly seen from Fig. 6 of the present application. This results from the fact that the first part 3 is formed in the process of connecting the semiconductor unit 2 with the device carrier 7. For at least this additional reason, amended claim 12 patently defines over *Grigg*.

Another difference between the claimed invention and *Grigg* is that the object of the prior art is to provide a solution to a problem (lines 44-60 of col. 1): expansion and contraction resulting from thermal cycling during manufacturing and testing process are serious at the

interface between a solder ball and a contact pad of a semiconductor device, causing solder fatigue, reducing the strength of the solder balls, resulting in cracking and failure of the solder balls, and diminishing the reliability of the solder balls as mechanical and electrical connection elements. In contrast, one object of the embodiment recited in claim 12 is to provide a solution to a problem (lines 14-21 of page 1): in conventional arts of connecting a chip via bumps to a lead frame or a device carrier having neither connection pads nor insulation layer thereon, reflow soldering (heat applying) process always results in bumps' collapses of inconsistent height due to disunity of wetty (or solder flowing) on the surface of such a device carrier, because of the lack of mechanism to limit the solder flowing. Another object of the embodiment recited in claim 12 is to provide a solution to another problem: in conventional arts of connecting a chip via bumps to a lead frame or a device carrier having neither connection pads nor insulation layer thereon, the chip contacts the device carrier as a result of bumps' collapses of inconsistent height due to disunity of wetting (or solder flowing) on the surface of such a device carrier.

For at least the foregoing, independent reasons, independent claim 12 (as amended) patently defines over *Grigg*.

The embodiments defined by amended independent claim 12 define over the USP 6,369,451 in at least the ways described below.

The Office Action also rejected independent claim 12 under 35 U.S.C. § 102(e) as allegedly unpatentable over U.S. Patent 6,369,451 to Lin. As noted above, Applicant has amended claim 12, and for at least the reasons set forth below, Applicant respectfully submits that amended claim 12 defines over Lin.

In this regard, the device carrier of Lin is a substrate 210 or 210' with joining pad thereon. In contrast, the device carrier according to the claimed embodiments is composed of a

metal surface 72 and a lead frame 7 enclosed by the metal surface 72, i.e., the device carrier according to the claimed embodiments is enclosed by a metal surface. For at least this additional reason, amended claim 12 patently defines over *Lin*.

Another difference relates to the interconnection portion. The second part of the interconnection portion of *Lin* is in series with a joining pad to connect device carrier such as substrate 210 or 210'. In contrast, the second part of the interconnection portion according to the claimed embodiments directly connects device carrier, i.e., directly connects the metal surface enclosing device carrier (lines 14-15 of page 5). The joining pad on substrate 210 or 210' according to the prior art is indispensable to the forming of the interconnection portion, because solder balls 125 or 225 must be placed on a joining pad (as shown in Figs. 1, 2 and 3), which is a metal unit on the surface of the device carrier (substrate 110 or 210 or 210') and is surrounded by an insulation layer constituting the surface of the device carrier. In contrast, for the interconnection portion to connect the device carrier according to the claimed embodiments, there is no need of either a joining pad or insulation layer which has to surround the joining pad.

For at least the foregoing reasons, amended claim 12 patently defines over *Lin*.

The embodiments defined by amended independent claim 12 clearly define over AAPA in at least the ways described below

In addition to the foregoing distinctions over the cited art, Applicant wishes to further note that the claimed embodiments clearly define over Applicant's admitted prior art (AAPA). In this regard, the claimed embodiments clearly define over the teachings of Fig. 1a and Fig. 1b. Specifically, these figures illustrate the unreality, infeasibility, or impracticality, of connecting a chip bump to a lead frame 101 enclosed by a metal surface 82. Fig. 1c, characterizing the embodiment according to U.S. Patent 6,184,573. The claimed embodiments differ from the

AAPA in at least the ways described below.

The device carrier according to the AAPA (Fig. 1c) includes a lead frame 101 and a mask layer 22, wherein surface 82 of the lead frame 101 is covered by the mask layer 22. In contrast, the device carrier according to the claimed embodiments is composed of a metal surface 72 and a lead frame 7 enclosed by the metal surface 72. Another difference is in the interconnection portion. The interconnection portion according to the AAPA is composed of only one part, and is surrounded by the mask layer 22 of device carrier. In contrast, the interconnection portion according to the claimed embodiments is composed of two parts with different melting points, wherein only the end thereof which is on device carrier is surrounded by device carrier, i.e., by the metal surface of device carrier.

In contrast, the device carrier according to the claimed embodiments is composed of a metal surface and a lead frame enclosed by the metal surface, and therefore is different from those disclosed in the prior arts. The difference is critical because of its relevance to the feasibility, reality, or practicality, of directly connecting a semiconductor unit to a device carrier fully enclosed by a metal surface.

The interconnection portion according to the claimed embodiments includes two parts both directly contacting device carrier, neither in series with joining pad which is surrounded by insulation layer, nor itself surrounded by mask layer, and therefore is different from those disclosed in the prior arts. The difference is also critical because of its relevance to the feasibility, reality, or practicality, of directly connecting a semiconductor unit to a device carrier having neither joining pad thereon surrounded by insulation layer nor mask layer to surround a joining portion thereon. The most significant feature of the claimed embodiments is that a semiconductor unit and a device carrier fully enclosed by a metal surface are connected via an

interconnection portion including two parts with different melting points. As a result of the feature, it becomes realistic to have practical apparatus in which a semiconductor unit is connected via an interconnection portion to a device carrier having neither joining pad thereon surrounded by insulation layer nor mask layer to surround a joining portion thereon.

The features included in amended independent claim 12 are neither anticipated nor suggested by the combination of U.S. Patents 6,506,671 and 6,369,451 and AAPA, not to mention that the teaching or suggestion to make the claimed embodiments and the reasonable expectation of success of the claimed embodiments were not both found in the prior art. Indeed, Applicant submits that, had reasonable expectation of success been found in the prior art, which was published more than 3 years ago, there should have been a lot of art disclosed up to now to provide practical apparatus where a chip is connected via an interconnection portion to a device carrier enclosed by a metal surface (i.e., to a device carrier without need of, either a joining pad formed thereon and surrounded by insulation layer, or mask layer to surround a joining portion formed thereon). The absence of such art underscores the inventive and nonobvious nature of the Applicant's claimed embodiments.

In determining the differences between the prior art and the claimed embodiments, the relevant question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious (*Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871, Fed. Cir. 1983; *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698, Fed. Cir. 1983). To establish a case of obviousness, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure (*In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438, Fed. Cir. 1991). The fact the references relied upon

teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a case of obviousness without some objective reason to combine the teachings of the references (*Ex parte Levengood*, 28 USPQ2d 1300; *In re Kotzab*, 217 F.3d 1365, 1371, 55 USPQ2d 1313, 1318, Fed. Cir. 2000). Furthermore, secondary considerations such as "synergistic result" or "long felt but unsolved needs" of a claimed invention may be counted in the determination of obviousness (*Graham v. John Deere*, 383 U.S. 1, 148 USPQ 459; *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 189 USPQ 449; and *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 163 USPQ 673).

The features included in independent claim 12 are neither anticipated by nor suggested by any prior art of which Applicant currently is aware. Accordingly, claim 12 overcomes the Examiner's rejections under 35 U.S.C. 103(a), and is in condition for allowance. Claims 13- 20 depend on claim 12, and all such dependent claims therefore are in condition for allowance and such action is respectfully requested.

As a separate and independent basis for the patentability of claims 15, 16, 17, and 19, Applicant respectfully submits that the Office Action has failed to cite a proper suggestion or motivation for combining *Lin* with *Grigg* (in rejecting claims 15 and 19) or for combining *Lin* with *Grigg* with *AAPA* (in rejecting claims 16 and 17). In combining *Lin* with *Grigg*, the Office Action stated only that it would have been obvious "in order to provide the interconnection portions with unchanged in their original shapes." (Office Action, p. 5, citing col. 5, lines 12-13). Likewise, in combining *Grigg* with *AAPA*, the Office action stated only that the combination would be obvious "in order to improve an efficiency and design flexibility in mounting the

semiconductor package device.”) Similarly, in combining Lin with AAPA, the Office Action stated only that the combination would be obvious “in order to improve an efficiency and design flexibility in mounting the semiconductor package device.” These alleged motivations are clearly improper in view of well-established Federal Circuit precedent.

It is well-settled law that in order to properly support an obviousness rejection under 35 U.S.C. § 103, there must have been some teaching in the prior art to suggest to one skilled in the art that the claimed invention would have been obvious. *W. L. Gore & Associates, Inc. v. Garlock Thomas, Inc.*, 721 F.2d 1540, 1551 (Fed. Cir. 1983). More significantly,

“The consistent criteria for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this [invention] should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art. ...” Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure... In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for the person of ordinary skill in the art is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention.”

(*Emphasis added.*) In re Dow Chemical Company, 837 F.2d 469, 473 (Fed. Cir. 1988).

In this regard, Applicant notes that there must not only be a suggestion to combine the functional or operational aspects of the combined references, but that the Federal Circuit also requires the prior art to suggest both the combination of elements and the structure resulting from the combination. *Stiftung v. Renishaw PLC*, 945 Fed.2d 1173 (Fed. Cir. 1991). Therefore, in order to sustain an obviousness rejection based upon a combination of any two or more prior art references, the prior art must properly suggest the desirability of combining the particular elements to derive an interconnection structure, as claimed by the Applicant.

When an obviousness determination is based on multiple prior art references, there must be a showing of some “teaching, suggestion, or reason” to combine the references. *Gambro*

Lundia AB v. Baxter Healthcare Corp., 110 F.3d 1573, 1579, 42 USPQ2d 1378, 1383 (Fed. Cir. 1997) (also noting that the “absence of such a suggestion to combine is dispositive in an obviousness determination”).

Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, inter alia, from the references themselves, the knowledge of one of ordinary skill in the art, or from the nature of the problem to be solved. See *In re Dembiczak*, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Although a reference need not expressly teach that the disclosure contained therein should be combined with another, the showing of combinability, in whatever form, must nevertheless be “clear and particular.” *Dembiczak*, 175 F.3d at 999, 50 USPQ2d at 1617.

If there was no motivation or suggestion to combine selective teachings from multiple prior art references, one of ordinary skill in the art would not have viewed the present invention as obvious. See *In re Dance*, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); *Gambro Lundia AB*, 110 F.3d at 1579, 42 USPQ2d at 1383 (“The absence of such a suggestion to combine is dispositive in an obviousness determination.”).

Significantly, where there is no apparent disadvantage present in a particular prior art reference, then generally there can be no motivation to combine the teaching of another reference with the particular prior art reference. *Winner Int'l Royalty Corp. v. Wang*, No 98-1553 (Fed. Cir. January 27, 2000).

Although the suggestion to combine references may flow from the nature of the problem, see *Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc.*, 75 F.3d 1568, 1573, 37 USPQ2d 1626, 1630 (Fed. Cir. 1996), “[d]efining the problem in terms of its solution reveals improper hindsight in the selection of the prior art relevant to obviousness,” *Monarch Knitting Mach. Corp. v. Sulzer*

Morat GmbH, 139 F.3d 877, 880, 45 USPQ2d 1977, 1981 (Fed.Cir.1998). Therefore, "[w]hen determining the patentability of a claimed invention which combines two known elements, 'the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination.' " *In re Beattie*, 974 F.2d 1309, 1311-12, 24 USPQ2d 1040, 1042 (Fed.Cir.1992) (quoting *Lindemann*, 730 F.2d at 1462, 221 USPQ at 488).

The motivation alleged by the Office Action (i.e., "to provide the interconnection with unchanged in their original shapes") is clearly insufficient, in view of the foregoing Federal Circuit precedent. Indeed, the motivation must be present in the prior art itself, and must be such that it would lead an artisan to make the particular combination without the benefit of hindsight. Here, the alleged motivation clearly does not satisfy these requirements. For at least these additional reasons, the rejections of claims 15 and 19 under 35 U.S.C. § 103(a) should be withdrawn.

Even more telling is the rejections of claims 16 and 17, in which the Office Action independently combined Lin and Grigg with the AAPA, citing the IDENTICAL motivation for both. Under the rationale adopted by the Office Action, the AAPA could be combined with ANY reference. In this regard, the Office Action relied upon the teaching of FIG. 1 of AAPA as justifying the combinations. Since FIG. 1 will always be a part of the AAPA, the rationale adopted by the Office Action would allow the AAPA to combined with any reference in existence. Clearly, this rationale is not supported or justified by the Federal Circuit precedence, and as such the rejections should be withdrawn.


For at least the foregoing reasons, Applicant respectfully submits that the rejections of claims 12-20 should be withdrawn.

CONCLUSION

In view of the foregoing, it is believed that all pending claims are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

No fee is believed to be due in connection with this amendment and response to Office Action. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,

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